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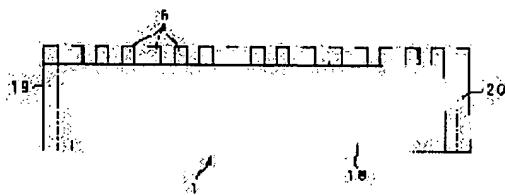
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## (54) NANAQUEOUS ELECTROLYTE SECONDARY BATTERY

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To suppress the occurrence of internal short circuit in the case where a wound electrode body is formed by fixing a positive electrode and a negative electrode to a winding core and winding, thus improving reliability.

**SOLUTION:** An ionic insulator is arranged between a positive mixture layer and a negative mixture layer so as to correspond to the thin part of the positive mixture layer and/or the negative mixture of a positive electrode 1 and/or a negative electrode of a layered product fixed to a winding core and wound around it. In the case where the positive electrode 1 is formed so that the positive mixture layer 18 has a thin part on the outermost circumferential side end side and/or the innermost circumferential side end side except for the outermost circumferential side end side and/or the innermost circumferential side end of a positive electrode current collector, ionic insulators 19, 20 are arranged between the positive mixture layer 18 and the negative mixture layer so as to correspond to the thin part of the positive mixture layer 18 on the outermost circumferential side end side and/or the innermost circumferential side end side of the positive electrode 1.



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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to a nonaqueous electrolyte rechargeable battery. In detail, it is arranging an ion insulator on a position, and generating of a short circuit is suppressed and it is involved in the nonaqueous electrolyte rechargeable battery whose dependability improved.

[0002]

[Description of the Prior Art] Conventionally, the nickel-cadmium battery, the lead cell, etc. are used as a rechargeable battery of electronic equipment. However, with the advance of an electronic technique, high-performance-izing of electronic equipment, a miniaturization, and portable-ization progressed, the demand to forming the rechargeable battery for electronic equipment into a high energy consistency became strong, therefore by the nickel-cadmium battery or the lead cell, discharge voltage was low and it had become a problem that an energy density cannot be made high enough in recent years.

[0003] Then, discharge voltage is high and research and development in the nonaqueous electrolyte rechargeable battery with which self-discharge used for the negative electrode a dope and the matter which can be dedoped for a lithium ion like a carbon material instead of the nickel-cadmium battery, the lead cell, etc. recently, and used lithium multiple oxides, such as a lithium cobalt multiple oxide, for the positive electrode as a large rechargeable battery of a cycle life few came to be done briskly.

[0004] In such a nonaqueous electrolyte rechargeable battery, in order to acquire a good property about heavy-loading discharge, a cycle life, etc., generally the electrode structure is made into rolled electrode object structure.

[0005] namely, both sides of a positive-electrode charge collector -- a positive electrode -- the band-like positive electrode which has the positive-electrode binder layer which applied the mixture and was formed, and this -- the same -- both sides of a negative-electrode charge collector -- a negative electrode -- he is trying to form winding and a rolled electrode object for the band-like negative electrode which has the negative-electrode binder layer which applied the mixture and was formed through a separator. In addition, in order to prevent the internal short circuit by deposit of the lithium at the time of charge generally in this case, the negative electrode which counters a positive electrode is made with size rather than the positive electrode about width of face and length.

[0006] And he is trying to contain the above-mentioned rolled electrode object in a cell can in the above-mentioned nonaqueous electrolyte rechargeable battery.

[0007] In order to manufacture such a nonaqueous electrolyte rechargeable battery, after carrying out the laminating of the above-mentioned positive electrode and the negative electrode through a separator, winding this, considering as a rolled electrode object and containing this rolled electrode object with a cell can, he inserts the member of the shape of a rod called a center pin in the core of a rolled electrode object, and is trying to maintain the winding configuration of a rolled electrode object.

[0008] In addition, in the above-mentioned nonaqueous electrolyte rechargeable battery, since a rolled electrode object is contained in a cell can, a positive electrode is easy to be pressed at the outermost periphery side, and it is easy to generate the internal short circuit by the positive-active-material elution

at the time of the continuation charge under an elevated-temperature ambient atmosphere, or preservation. Then, he arranges an ion insulator between the negative electrodes which counter this the outermost periphery side of a positive electrode, and was trying to cancel the above inconvenience, as shown in JP,5-182691,A. The above-mentioned ion insulator means the ingredient with which ion is insulated, and the ingredient which has conductivity is also contained.

[0009] However, in the above-mentioned nonaqueous electrolyte rechargeable battery, it sets to a most-inner-circumference side, and is hard to generate the internal short circuit by the positive-active-material elution at the time of the continuation charge under an elevated-temperature ambient atmosphere, or preservation. In the above-mentioned nonaqueous electrolyte rechargeable battery, this is inserting the center pin, after containing a rolled electrode object with a cell can, a clearance exists in the center-pin and most-inner-circumference side of a rolled electrode object, and a rolled electrode object can be loosened to a core side, and is considered for not receiving pressure.

[0010]

[Problem(s) to be Solved by the Invention] By the way, in the above nonaqueous electrolyte rechargeable batteries, the procedure in which the manufacture is shown below performs increasingly. first, both sides of a positive-electrode charge collector -- a positive electrode -- the band-like positive electrode which has the positive-electrode binder layer which applied the mixture and was formed, and both sides of a negative-electrode charge collector -- a negative electrode -- the layered product which carried out the laminating of the band-like negative electrode which has the negative-electrode binder layer which applied the mixture and was formed through the separator is prepared. Next, this layered product is fixed to the winding core used as a center pin, a layered product is wound centering on this winding core, and a rolled electrode object is formed. Subsequently, this rolled electrode object is contained in a cell can.

[0011] That is, after containing a rolled electrode object in a cell can, winding a layered product around the winding core which functions as a center pin to having inserted the center pin and forming a rolled electrode object before, he is trying to contain this with a cell can.

[0012] Thus, inconvenience as shown below has arisen by having changed the production process. In such a nonaqueous electrolyte rechargeable battery, in order to prevent the internal short circuit by deposit of the lithium at the time of charge as mentioned above, the negative electrode which counters a positive electrode makes thickness of a negative-electrode binder layer thicker than a positive-electrode binder layer while making it into size rather than a positive electrode about width of face and length. Moreover, in the above-mentioned positive electrode, it leaves an outermost periphery side edge section [ of a positive-electrode charge collector ], and/or most-inner-circumference side edge section side, and the positive-electrode binder layer is formed so that thickness may have a thin part in an above-mentioned outermost periphery side edge section and/or most-inner-circumference side edge section side.

[0013] For this reason, since the difference of the thickness of a positive-electrode binder layer and a negative-electrode binder layer is dramatically large and enough lithiums for a negative electrode cannot be supplied to a most-inner-circumference side edge section and/or most-inner-circumference side edge section side, the dissolution of the positive active material of a positive electrode arises at the time of the continuation charge and preservation under an elevated-temperature ambient atmosphere, and it is easy to generate an internal short circuit.

[0014] Moreover, it is in the condition that the positive electrode and the negative electrode were strongly pushed to a winding core at the most-inner-circumference side edge section side, the positive-electrode binder layer edge by the side of the most-inner-circumference side edge section of a positive electrode tends to be pressed by especially expansion of the negative electrode at the time of charge, local potential lifting takes place, and it is easy to generate an internal short circuit also from this.

[0015] Then, this invention is proposed in view of the above-mentioned actual condition, even if a negative electrode and a positive electrode carry out fixed winding of the layered product by which the laminating was carried out at a winding core and form a rolled electrode object through a separator, it is hard to generate an internal short circuit, and dependability tends to offer a good nonaqueous electrolyte

rechargeable battery.

[0016]

[Means for Solving the Problem] In order to solve an above-mentioned technical problem, the nonaqueous electrolyte rechargeable battery concerning this invention The band-like positive electrode with which it comes to form a positive-electrode binder layer in one [ at least ] principal plane side of a positive-electrode charge collector, The band-like negative electrode with which it comes to form a negative-electrode binder layer in one [ at least ] principal plane side of a negative-electrode charge collector It is fixed to a winding core and the layered product by which the laminating was carried out through the separator has the rolled electrode object around which it comes to wind this winding core as a core. This rolled electrode object is the nonaqueous electrolyte rechargeable battery which it comes to contain in a cell can, and it is characterized by arranging the ion insulator between the above-mentioned positive-electrode binder layer and a negative-electrode binder layer corresponding to a part with the thickness of the above-mentioned positive-electrode binder layer and/or a negative-electrode binder layer thin at least.

[0017] The above-mentioned ion insulator means the film made of resin which does not have such a big pore that ion can be passed.

[0018] Moreover, it sets to the nonaqueous electrolyte rechargeable battery of above-mentioned this invention. A positive-electrode binder layer leaves [ the above-mentioned positive electrode ] an outermost periphery side edge section [ of a positive-electrode charge collector ], and/or most-inner-circumference side edge section side. It is what is formed and becomes so that it may have a part with thin thickness in an above-mentioned outermost periphery side edge section and/or most-inner-circumference side edge section side. It is what it is formed in and the above-mentioned negative electrode becomes so that the thickness of a negative-electrode binder layer may not change in the part to which the thickness of the positive-electrode binder layer by the side of the outermost periphery side edge section and/or the most-inner-circumference side edge section counters a thin part. It is desirable that the ion insulator is arranged corresponding to a part with the thin thickness of the positive-electrode binder layer by the side of the outermost periphery side edge section of the above-mentioned positive electrode and/or the most-inner-circumference side edge section between the above-mentioned positive-electrode binder layer and a negative-electrode binder layer.

[0019] Furthermore, in the nonaqueous electrolyte rechargeable battery of above-mentioned this invention, it is desirable that the negative-electrode binder layer of the above-mentioned negative electrode consists of a carbon material in which a dope and a dedope of a lithium are possible, and the positive-electrode binder layer of the above-mentioned positive electrode consists of a transition-metals multiple oxide containing a lithium.

[0020] The nonaqueous electrolyte rechargeable battery of this invention is contained in the cell can, it is fixed to a winding core, and the ion insulator is arranged corresponding to the part with the thin thickness of the positive-electrode binder layer of the positive electrode of a layered product currently wound around this, and/or a negative electrode, and/or a negative-electrode binder layer between the above-mentioned positive-electrode binder layer and the negative-electrode binder layer. For this reason, even if an active material is eluted from a part with such thin thickness, the migration to the electrode of the opposite hand of this eluted active material is prevented by the ion insulator, and an internal short circuit is prevented. Moreover, even if a part with such thin thickness is pressed, local potential lifting does not arise from the ion insulator being arranged, but an internal short circuit is prevented.

[0021] Furthermore, in the nonaqueous electrolyte rechargeable battery of above-mentioned this invention, a positive-electrode binder layer leaves [ the above-mentioned positive electrode ] an outermost periphery side edge section [ of a positive-electrode charge collector ], and/or most-inner-circumference side edge section side. It is what is formed and becomes so that it may have a part with thin thickness in an above-mentioned outermost periphery side edge section and/or most-inner-circumference side edge section side. It is what it is formed in and the above-mentioned negative electrode becomes so that the thickness of a negative-electrode binder layer may not change in the part to which the thickness of the positive-electrode binder layer by the side of the outermost periphery side

edge section and/or the most-inner-circumference side edge section counters a thin part. If the ion insulator is arranged corresponding to the part with the thin thickness of the positive-electrode binder layer by the side of the outermost periphery side edge section of the above-mentioned positive electrode, and/or the most-inner-circumference side edge section between the above-mentioned positive-electrode binder layer and the negative-electrode binder layer. While the thickness of a positive-electrode binder layer and a negative-electrode binder layer differs greatly, an internal short circuit is prevented at an outermost periphery side edge section [ which a positive electrode is easy to be pressed ], and/or most-inner-circumference side edge section side.

[0022] Furthermore, in the nonaqueous electrolyte rechargeable battery of above-mentioned this invention, when the negative-electrode binder layer of the above-mentioned negative electrode is formed with the carbon material in which a dope and a dedope of a lithium are possible and the positive-electrode binder layer of the above-mentioned positive electrode is formed with the transition-metals multiple oxide containing a lithium, even if a negative-electrode binder layer expands at the time of charge, a positive electrode cannot receive pressure easily, and it is hard to generate an internal short circuit.

[0023]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained, referring to a drawing.

[0024] The nonaqueous electrolyte rechargeable battery which applied this invention is suitable as a power source of portable electronic equipment, such as a camera one apparatus video tape recorder, a cellular phone, and a laptop computer. Moreover, the nonaqueous electrolyte rechargeable battery which applied this invention is suitable also as a hybrid mold electric vehicle, a power source for engine start up, etc. In addition, when using it as a hybrid mold electric vehicle, a power source for engine start up, etc., discharge and charge are performed by a short time for about several seconds, and large power in many cases, and greater importance is attached than to capacity to output density.

[0025] As a nonaqueous electrolyte rechargeable battery which applied this invention, a thing as shown in drawing 1 is mentioned.

[0026] That is, as shown in drawing 1, it considers as a layered product through the separator which does not illustrate the negative electrode 2 with which spreading formation of the negative-electrode binder layer was carried out to both sides of a positive-electrode charge collector to both sides of the positive electrode 1 with which spreading formation of the positive-electrode binder layer was carried out, and a negative-electrode charge collector, the end of the longitudinal direction of this layered product is fixed to a winding core 3, and it comes to contain the rolled electrode object 4 which wound the layered product on the peripheral surface of a winding core 3 in this condition in the cell can 5.

[0027] In addition, as the positive-electrode lead 6 is formed in the above-mentioned positive electrode 1 at the predetermined spacing as shown in drawing 2, and shown in drawing 1, the positive-electrode lead 6 will be drawn for every layer of the direction of a laminating. And these positive-electrodes lead 6 is packed into the pole pillar 7 which is bundled by the prevention jig, for example, consists of pure aluminium etc. by technique, such as laser welding, and is connected to it.

[0028] As it is the same also in one above-mentioned negative electrode 2, the negative-electrode lead 8 is formed at the predetermined spacing and it is shown in drawing 1, the negative-electrode lead 8 will be drawn for every layer of the direction of a laminating. And these negative-electrodes lead 8 is packed into the pole pillar 9 which is bundled by the prevention jig, for example, consists of a pure copper etc. by technique, such as laser welding, and is connected to it.

[0029] furthermore -- the near edge at which the positive electrode 6 of the cell can 5 is bundled as shown in drawing 1 -- the positive-electrode lid 10 -- a gasket 11 and the ceramic thrust reliance 12 -- minding -- closing -- a mounting eclipse -- it is further fastened by the nut 13 and is welded to the cell can 5 by technique, such as laser welding.

[0030] the near edge at which the negative electrode 8 is bundled on the other hand -- the negative-electrode lid 14 -- a gasket 15 and the ceramic thrust reliance 16 -- minding -- closing -- a mounting eclipse -- it is further fastened by the nut 17 and is welded to the cell can 5 by technique, such as laser

welding.

[0031] That is, it is constituted so that the point of nuts 13 and 17 may function as the positive electrode and negative electrode of a cell. Moreover, it cannot be overemphasized that it fills up with the electrolytic solution into this cell can 5.

[0032] And in the nonaqueous electrolyte rechargeable battery of this example, as shown in drawing 2, it shall be formed in the positive-electrode binder layer 18 so that a positive electrode 1 may leave the both ends of a positive-electrode charge collector and may have a part with thin thickness in these both-ends side.

[0033] Furthermore, in the nonaqueous electrolyte rechargeable battery of this example, especially, as a part for the positive-electrode current collection soma by the side of the ends of a positive electrode 1 and a part with the thin thickness of the positive-electrode binder layer 18 are covered, the ion insulators 19 and 20 of a flat-surface rectangle are arranged.

[0034] In one negative electrode 8, although it leaves the both ends of a negative-electrode charge collector and the negative-electrode binder layer is formed, in the direction which intersects perpendicularly with a longitudinal direction and this, it is broadly formed rather than the positive-electrode binder layer 18.

[0035] Namely, if the up Norikazu edge of the layered product which doubled the end of these positive electrodes 1 and a negative electrode 2, and carried out the laminating through the separator is fixed and wound around a winding core, it will set to a positive electrode 1. The thickness of a negative-electrode binder layer does not change to an outermost periphery side edge section and most-inner-circumference side edge section side in the part which counters a part with the thin thickness of a positive-electrode binder layer, and the thin thickness of the positive-electrode [ set to a negative electrode 8 and ] binder layer by the side of the outermost periphery side edge section and the most-inner-circumference side edge section.

[0036] And corresponding to the part with the thin thickness of the positive-electrode binder layer 18 by the side of the outermost periphery side edge section of the above-mentioned positive electrode 1, and the most-inner-circumference side edge section, the ion insulators 19 and 20 will be arranged between the above-mentioned positive-electrode binder layer 18 and the negative-electrode binder layer.

[0037] The film made of resin which does not have such a big pore as such ion insulators 19 and 20 that ion can be passed is mentioned, and electric conduction is not barred. Moreover, in the ion insulators 19 and 20, it needs to be insoluble to the electrolytic solution. More specifically, that in which the glue line was prepared is mentioned to the films and these films made of resin, such as polypropylene, polyethylene, polyimide, and poly tetrafluoroethylene.

[0038] In this example, although the ion insulators 19 and 20 are arranged on a positive electrode 1, these ion insulators 19 and 20 may be formed in the negative-electrode up etc. on a separator that what is necessary is to just be allotted between the positive-electrode binder layer and the negative-electrode binder layer.

[0039] In this example, although a positive electrode 1 and a negative electrode 2 are considered as the above configurations, each ingredient usually used for the binder layer which constitutes a positive electrode 1 and a negative electrode 2, or the charge collector is usable.

[0040] First, a positive-electrode binder layer contains a lithium ion, and a dope, the positive-electrode ingredient which can be dedoped, an electric conduction agent, and a binder are constituted in it.

[0041] It is desirable that sufficient Li is included as a positive-electrode ingredient, for example, the intercalation compound containing the compound metallic oxide which consists of a lithium expressed with  $\text{LiMO}_2$  (however, M is at least one sort of Co, nickel, Mn, Fe, aluminum, V, and Ti.) and transition metals, or Li etc. is suitable.

[0042] What is usually used as a binder for holding the electric conduction agent for giving conductivity to a positive electrode and a positive-electrode ingredient to a positive-electrode charge collector can be used. For example, fluororesin, such as polyvinylidene fluoride, is used as a binder.

[0043] For example, as an electric conduction agent, fluororesin, such as polyvinylidene fluoride, is suitably used as graphite, carbon black, and a binder, respectively.

[0044] Moreover, a negative-electrode binder layer contains a lithium ion, and a dope, and the negative-electrode ingredient and binder which can be dedoped are constituted in it.

[0045] As a negative-electrode ingredient, a carbon material etc. is used, for example. As this carbon material, pyrolytic carbon, corks (pitch coke, needle coke, petroleum coke, etc.), graphite, glassy carbon, organic high-molecular-compound baking objects (what calcinated phenol resin, furan resin, etc.), a carbon fiber, activated carbon, etc. are mentioned. As a negative-electrode ingredient, a dope, the crystalline substance which can be dedoped, or an amorphous substance metallic oxide is also used in the lithium ion other than a carbon material.

[0046] What is usually used as a binder for holding a negative-electrode ingredient to a negative-electrode charge collector can be used. For example, fluororesin, such as polyvinylidene fluoride, is used as a binder.

[0047] Moreover, by this cell, the nonaqueous electrolyte currently used from the former which dissolved the electrolyte in a non-aqueous solvent like an organic solvent is used.

[0048] Especially as the above-mentioned organic solvent, although it does not limit, propylene carbonate, ethylene carbonate, 1, 2-dimethoxyethane, 1, 2-JIMEEKISHI ethane, diethyl carbonate, gamma-butyrolactone, a tetrahydrofuran, 1, 3-dioxolane, the 4-methyl -1, 3-dioxolane, diethylether, a sulfolane, a methyl sulfolane, an acetonitrile, propionitrile, etc. are illustrated, and it is used as these independent or two or more kinds of mixed solvents.

[0049] although it is not what is limited especially as an electrolyte --  $\text{LiClO}_4$ ,  $\text{LiAsF}_6$  and  $\text{LiPF}_6$ ,  $\text{LiBF}_4$ ,  $\text{LiB}(\text{C}_6\text{H}_5)_4$ ,  $\text{LiCl}$ ,  $\text{LiBr}$ ,  $\text{LiSO}_3\text{CH}_3$ , and  $\text{LiSO}_3\text{CF}_3$  etc. -- it is mentioned.

[0050] Especially as a separator, although it does not limit, textile-fabrics, nonwoven fabric, and synthetic-resin fine porous membrane etc. is mentioned. Although synthetic-resin fine porous membrane is used especially suitably, polyolefine system fine porous membrane is suitably used in respect of thickness, film reinforcement, membrane resistance, etc. also in it. Specifically, polyethylene and the fine porous membrane made from polypropylene, or the fine porous membrane that compounded these is used.

[0051] Especially as a configuration of the charge collector of an electrode, although it does not limit, reticulated things, such as the shape of a foil, a mesh, and an expanded metal, are used. As construction material used for a positive-electrode charge collector, it is desirable to, use aluminum, stainless steel, nickel, etc. for example. As construction material used for a negative-electrode charge collector, it is desirable to, use copper, stainless steel, nickel, etc. for example.

[0052] Moreover, iron, nickel, stainless steel, aluminum, etc. are illustrated as an ingredient which forms the cell can 5. When electrochemical corrosion occurs in nonaqueous electrolyte during cell actuation using these, it may be made to perform plating etc.

[0053] As for the nonaqueous electrolyte rechargeable battery of this example, a positive-electrode binder layer leaves [ the above-mentioned positive electrode 1 ] an outermost periphery side edge section [ of a positive-electrode charge collector ], and most-inner-circumference side edge section side. It is what is formed and becomes so that it may have a part with thin thickness in an above-mentioned outermost periphery side edge section and most-inner-circumference side edge section side. It is what it is formed in and the above-mentioned negative electrode 2 becomes so that the thickness of a negative-electrode binder layer may not change in the part to which the thickness of the positive-electrode binder layer by the side of the outermost periphery side edge section and the most-inner-circumference side edge section counters a thin part. Corresponding to the part with the thin thickness of the positive-electrode binder layer 18 by the side of the outermost periphery side edge section of the above-mentioned positive electrode 1, and the most-inner-circumference side edge section, the ion insulators 19 and 20 are arranged between the above-mentioned positive-electrode binder layer 18 and the negative-electrode binder layer.

[0054] In the outermost periphery side edge section side which a positive electrode 1 is easy to be pressed from this while the thickness of the positive-electrode binder layer 18 and a negative-electrode binder layer differs greatly, and a most-inner-circumference side edge section side Even if positive active material is eluted, the migration to the negative electrode 2 of this eluted active material is



prevented by the ion insulators 19 and 20, even if these thin parts are pressed, local potential lifting does not arise from the ion insulators 19 and 20 being arranged, but an internal short circuit is prevented, and dependability becomes good.

[0055] Furthermore, in the nonaqueous electrolyte rechargeable battery of the example of the above-mentioned book, when the negative-electrode binder layer of the above-mentioned negative electrode 2 is formed with the carbon material in which a dope and a dedope of a lithium are possible and the positive-electrode binder layer of the above-mentioned positive electrode 1 is formed with the transition-metals multiple oxide containing a lithium, even if a negative-electrode binder layer expands at the time of charge, a positive electrode 1 cannot receive pressure easily, and it is hard to generate an internal short circuit.

[0056] If the ion insulators 19 and 20 are arranged like this example further again as a part for the positive-electrode current collection soma by the side of the ends of a positive electrode 1 and a part with the thin thickness of the positive-electrode binder layer 18 are covered, the positive-electrode charge collector which consists of aluminum, for example will be covered thoroughly, it will become possible to also prevent the internal short circuit resulting from the weld flash of this positive-electrode charge collector etc., and dependability will improve further.

[0057]

[Example] Next, the cell was manufactured actually and the property was investigated in order to check the effectiveness of this invention.

[0058] Manufacture place \*\*\*\*\* of a cell was manufactured.

[0059] first, a negative electrode -- although it was a mixture, after calcinating in an inert gas air current as a negative-electrode ingredient, the carbon material of the mean diameter 20 (micrometer) ground and obtained was prepared as 90 (weight section) and a binder as a slurry which made N-methyl pyrrolidone distribute 10 (weight section) for polyvinylidene fluoride resin.

[0060] And this was applied to the predetermined part of both sides of the negative-electrode charge collector which is copper foil of thickness 10 (micrometer), the negative-electrode binder layer was formed, and the whole thickness considered as the negative-electrode negative of 180 (micrometer). And the negative electrode of the direction where cut out the above-mentioned negative-electrode negative, a part of part in which the negative-electrode binder layer of this negative-electrode negative is not formed is made to remain in in order to form a negative-electrode lead, and 6940 (mm), this, and a longitudinal direction cross at right angles with which it has a part for an uncoated portion by 35 (mm) width of face up and down, and a negative-electrode binder layer is formed by 348 (mm) width of face was obtained. In addition, in the above-mentioned negative electrode, the negative-electrode lead of the shape of a strip of paper of width of face 10 (mm) and die length 30 (mm) was formed in the pitch of 15 (mm).

[0061] Next, the positive electrode was manufactured.

[0062] first, a positive electrode -- although it is a mixture -- as a positive-electrode ingredient --  $\text{LiCoO}_2$  of a mean diameter 15 (micrometer) Powder was prepared as 91 (weight section) and a binder as a slurry which made N-methyl pyrrolidone distribute 3 (weight section) for polyvinylidene fluoride resin.

[0063] Next, this was applied to the predetermined part of both sides of the positive-electrode charge collector which is the aluminium foil of thickness 20 (micrometer), the positive-electrode binder layer was formed, and the whole thickness considered as the positive-electrode negative of 150 (micrometer). In addition, the above-mentioned positive-electrode binder layer was formed so that it might have a part with thin thickness in the ends of the longitudinal direction of a positive-electrode charge collector. Next, the positive electrode of the direction where cut out the above-mentioned positive-electrode negative, a part of part in which the positive-electrode binder layer of this positive-electrode negative is not formed is made to remain in in order to form a positive-electrode lead, and 6940 (mm), this, and a longitudinal direction cross at right angles with which it has a part for an uncoated portion by 35 (mm) width of face up and down, and a positive-electrode binder layer is formed by 342 (mm) width of face was obtained. In addition, in the above-mentioned positive electrode, the positive-electrode lead of the shape of a strip of paper of width of face 10 (mm) and die length 30 (mm) was formed in the pitch of 15

(mm).

[0064] And the polyimide film was arranged for the part with the thin thickness of a positive-electrode charge collector and a positive-electrode binder layer on the both ends of the longitudinal direction of the above-mentioned positive electrode as a wrap ion insulator.

[0065] Moreover, the polyethylene film which has the micropore of extent which does not make the ion of the magnitude of 353x7600 (mm) penetrate by thickness 38 (micrometer) as a separator was prepared.

[0066] Next, the laminating was carried out to the order of the above-mentioned separator, a negative electrode, a separator, and a positive electrode, and the layered product was formed.

[0067] Furthermore, the winding core of an outer diameter 17 (mm), a bore 14 (mm), and die length 354 (mm) was prepared, the end of the above-mentioned layered product was fixed to this, it wound around it centering on the winding core, and the rolled electrode object was formed in it.

[0068] And this rolled electrode object was contained in the cell can in order to manufacture the nonaqueous electrolyte rechargeable battery previously shown in drawing 1, and the nonaqueous electrolyte rechargeable battery which has the same structure, the positive-electrode lead and the negative-electrode lead were packed into the pole pillar which consists of a pole pillar which consists of pure aluminium etc. in a bundle with a prevention jig, a pure copper, etc., and it connected by technique, such as laser welding.

[0069] next -- for example, the near edge at which the negative electrode is bundled -- a negative-electrode lid -- a gasket and ceramic thrust reliance -- minding -- the near edge at which anchoring and a positive electrode are bundled by closing -- a positive-electrode lid -- a gasket and ceramic thrust reliance -- minding -- closing -- a mounting beam.

[0070] Then, it was filled up with the electrolytic solution from pouring-in opening of a negative-electrode lid or a positive-electrode lid in the cell can. Especially the electrolytic solution is  $\text{LiBF}_4$  as an electrolyte to the mixed solvent of propylene carbonate and dimethyl carbonate here, although not limited. We decided to use what dissolved 1 (a mol/liter).

[0071] Subsequently, the nut fastened the above-mentioned positive-electrode lid and the negative-electrode lid, respectively, it welded to the cell can by technique, such as laser welding, and the nonaqueous electrolyte rechargeable battery was completed. In addition, suppose that this nonaqueous electrolyte rechargeable battery is called a sample 1.

[0072] Furthermore, we manufactured the same nonaqueous electrolyte rechargeable battery as a sample 1 except having changed the ion insulator of the above-mentioned sample 1 into poly tetrafluoroethylene, and decided to call this a sample 2.

[0073] We decided to arrange a polyethylene film for a positive-electrode charge collector and a positive-electrode binder layer as an ion insulator of wrap magnitude, to prepare for a positive electrode the nonaqueous electrolyte rechargeable battery which is not \*\*\*\* about an ion insulator, and to call this a sample 3 further again in the location corresponding to the both ends of the longitudinal direction of the positive electrode of the opposed face to the positive electrode of a separator.

[0074] Moreover, we decided to arrange a polypropylene film for a positive-electrode charge collector and a positive-electrode binder layer as an ion insulator of wrap magnitude, to prepare for a positive electrode the nonaqueous electrolyte rechargeable battery which is not \*\*\*\* about an ion insulator, and to call this a sample 4 in the location corresponding to the both ends of the longitudinal direction of the positive electrode of the opposed face to the positive electrode of a negative electrode.

[0075] And we manufactured the same nonaqueous electrolyte rechargeable battery as a sample 1, without arranging an ion insulator for a comparison, and decided to call this a sample 5.

[0076] Then, the incidence rate of the internal short circuit immediately after the prototype of each sample and the incidence rate of the internal short circuit after the retention test under an elevated temperature were investigated.

[0077] Consequently, it set to samples 1-4, and the incidence rate of the interior [ incidence rate / of the internal short circuit immediately after a prototype ] short circuit after the retention test under 0/100 and an elevated temperature was 0/5. On the other hand, it set to the sample 5 and the incidence rate of the

interior [ incidence rate / of the internal short circuit immediately after a prototype ] short circuit after the retention test under 2/100 and an elevated temperature was 5/5.

[0078] That is, like the nonaqueous electrolyte rechargeable battery of this invention, if the thickness of the positive-electrode binder layer of a positive electrode and/or a negative electrode and/or a negative-electrode binder layer arranges an ion insulator corresponding to a thin part between the above-mentioned positive-electrode binder layer and a negative-electrode binder layer, even if an active material is eluted from a part with such thin thickness, the migration to the electrode of the opposite hand of this eluted active material will be prevented by the ion insulator, and an internal short circuit will be prevented. Moreover, even if a part with such thin thickness is pressed, local potential lifting does not arise from the ion insulator being arranged, but an internal short circuit is prevented. It was checked that dependability improves from these things.

[0079] Moreover, according to this invention, it was checked that the dependability under an elevated temperature also improves.

[0080]

[Effect of the Invention] As mentioned above, in the nonaqueous electrolyte rechargeable battery concerning this invention, it is contained in the cell can, and is fixed to a winding core, and the ion insulator is arranged corresponding to the part with the thin thickness of the positive-electrode binder layer of the positive electrode of a layered product currently wound around this, and/or a negative electrode, and/or a negative-electrode binder layer between the above-mentioned positive-electrode binder layer and the negative-electrode binder layer. For this reason, an internal short circuit is prevented and high dependability is secured.

[0081] Furthermore, in the nonaqueous electrolyte rechargeable battery of above-mentioned this invention, a positive-electrode binder layer leaves [ the above-mentioned positive electrode ] an outermost periphery side edge section [ of a positive-electrode charge collector ], and/or most-inner-circumference side edge section side. It is what is formed and becomes so that it may have a part with thin thickness in an above-mentioned outermost periphery side edge section and/or most-inner-circumference side edge section side. It is what it is formed in and the above-mentioned negative electrode becomes so that the thickness of a negative-electrode binder layer may not change in the part to which the thickness of the positive-electrode binder layer by the side of the outermost periphery side edge section and/or the most-inner-circumference side edge section counters a thin part. If the ion insulator is arranged corresponding to the part with the thin thickness of the positive-electrode binder layer by the side of the outermost periphery side edge section of the above-mentioned positive electrode, and/or the most-inner-circumference side edge section between the above-mentioned positive-electrode binder layer and the negative-electrode binder layer While the thickness of a positive-electrode binder layer and a negative-electrode binder layer differs greatly, an internal short circuit is prevented and high dependability is secured to an outermost periphery side edge section [ which a positive electrode is easy to be pressed ], and/or most-inner-circumference side edge section side.

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[Translation done.]